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B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Second Semester

Mechanical Engineering

ME 132 — THERMODYNAMICS

Time : Three hours   Maximum : 100 marks

(Use of thermodynamic tables permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.   Write the difference between open and closed systems.

2.   State 'Zeroth law of thermodynamics'.

3.   Name the processes in Carnot cycle.

4.   What is the relationship between COP of the heat pump and refrigerator?

5.   Define 'Mole fraction'.

6.   State the laws of perfect gas.

7.   What is super saturated steam?

8.   Find the specific volume, enthalpy and entropy of saturated steam at 10 bar.

9.   What is meant by 'Adiabatic flame temperature'?

10. What is the mass of carbon-dioxide from one kg of carbon combustion?

PART B — (5 × 16 = 80 marks)

11. (a)   Determine the heat transfer and its direction for a system in which a perfect gas having molecular weight of 16 is compressed from 101.3 kPa, 20°C to a pressure of 600 kPa following the law $Pv^{1.3} = \text{constant}$. Take specific heat at constant pressure of gas as 1.7 kJ/kgK.   (16)

Or

(b) (i) In a cyclic process, heat transfer are $+14.7$ kJ, -25.2 kJ, -3.56 kJ and $+31.5$ kJ. What is the network for the cyclic process? (6)

(ii) Assume 4.0 kg/s of steam enters a turbine. The inlet of the turbine is 2.5 m higher than the outlet. The inlet velocity is 132 m/s. Outlet velocity is 327 m/s and heat loss is 9.2 kJ/s. The enthalpy at inlet and outlet of the turbine are 3127.4 kJ/kg, 2512 kJ/kg respectively. Determine the power output. (10)

12. (a) A reversible heat engine operates between two reservoirs at 827°C and 27°C. Engine drives a Carnot refrigerator maintaining –13°C and rejecting heat to reservoir at 27°C. Heat input to the engine is 2000 kJ and the network available is 300 kJ. How much heat is transferred to refrigerant and total heat rejected to reservoir at 27°C? (16)

Or

(b) A closed system contains 0.5 kg of air. It expands from 2 bar, 60°C to 1 bar at 40°C. During the expansion it receives 2 kJ of heat from the reservoir at 100°C. Assuming atmospheric conditions as 0.95 bar and 30°C. Calculate the (i) maximum work (ii) work done on atmosphere and (iii) change in availability. (16)

13. (a) The critical temperature, pressure and volume of Neon gas is 44.5 K, 27.3 bar, 0.0416 m^3/kg.mol. For a reduced pressure and temperature of 2 and 1.3, compressibility factor (z) is 0.7. What are the corresponding specific volume, pressure and temperature if the molecular weight is 20.183? Calculate the reduced volume. (16)

Or

(b) What are Maxwell relations? Derive the relations. (16)

14. (a) Explain the working principle of separating and throttling calorimeter with neat sketch. (16)

Or

(b) The steam initially at a pressure of 15 bar and 250°C expand reversibly and polytropically to 1.5 bar. Find the temperature, work done and change in entropy if the index of expansion is 1.25. (16)

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15. (a) (i) What are the advantages of liquid fuel over the solid fuels? (6)

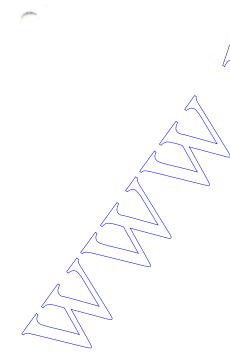(ii) Explain the working principle of Orsat apparatus with neat sketch. (10)

Or

(b) Determine the percentage excess air supplied to boiler for buring the coal having following composition on mass basis. $C = 0.82$; $H_2 = 0.05$; $O_2 = 0.08$; $N_2 = 0.03$; $S = 0.005$ and moisture $= 0.015$.

Volumetric analysis of dry flue gases shows the following composition :

$CO_2 = 10\%$; $CO = 1\%$; $N_2 = 82\%$; $O_2 = 7\%$. (16)

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